U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 259.

Experiment Station Work,

XXXV.

Compiled from the Publications of the Agricultural Experiment Stations.

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USE OF A CHEAP CANNING OUTFIT.

PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.

A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. BEAL and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. TRUE, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK.[a]

USE OF COMMERCIAL FERTILIZERS.[b]

In a recent bulletin of the New Hampshire Station, F. W. Morse thus briefly sets forth certain important facts which should always be clearly kept in mind in using fertilizers:

It should always be borne in mind that the success of a crop depends on four other conditions besides that of the fertilizer used to feed it. All farm crops require certain average amounts of heat, light, air, and water in order to develop an average growth, and just the right amount of each for the largest possible yield.

Thus weather conditions may favor or hinder a crop to such an extent that the fertilizer has apparently no effect, and these facts have led more than one to the conclusion that fertilizers were useless. * * *

Fertilizers can not make good a lack of sunshine or rain, but they can help the sunshine and rain to do their best; therefore when the weather is favorable they increase the profits and when it is unfavorable they lessen the losses.

The condition of the soil in its relation to air and water is of the greatest importance in the profitable use of commercial fertilizers. When a soil is too wet, it allows too little air to reach the roots of plants, simply because the water crowds it out. In average seasons some soils are too wet and others are too dry for the following reasons: A crop of 3 tons of hay or one of 15 tons of silage corn per acre would result in the removal from the soil of about 800 tons of water. To supply this water, there would need to be between 7 and 8 inches of rainfall during the growing season of each crop. At Durham, the average rainfall in April, May, and June is 9.5 inches, and during May, June, July, and August it is 12.8 inches. If this rain were uniformly distributed, it would be fully enough for grass and a little too much for corn. As it is not, both crops need the soil in such condition that it will hold enough water at all times for their needs, while allowing the surplus to drain away.

On soils of average texture the requisite moisture conditions can be maintained by tillage, and if needed, by drainage on low levels; but with extreme types, as heavy clay loams or light sandy loams, there is needed more thorough treatment by increasing the amount of vegetable matter, since there is no more effective way of making over a soil in its relation to water and air than this.

In using commercial fertilizers as a source of the food elements needed by crops, it should be remembered that there is little positive evidence that they can make over the soil in its relation to water, hence they always do their best work and are most profitable on soils which are in good average condition, neither too heavy and wet nor too light and dry. Furthermore, the continuous growth of annual crops, whether hoed or broadcast, adds no vegetable matter to the soil, except in the roots and stubble, and it is common to find that the first crop

[a] A progress record of experimental inquiries, published without assumption of responsibility by the Department for the correctness of the facts and conclusions reported by the stations.

[b] Compiled from New Hampshire Sta. Bul. 123.

of corn on sod land, with commercial fertilizers, is superior to that of the second year, undoubtedly because the vegetable matter of the old turf helped maintain a satisfactory moisture condition in the first year and was largely destroyed before the second year.

The most economical use of commercial fertilizers is only reached when they are applied in rotations in which the soil is maintained in good moisture condition by the use of barnyard manure or the vegetable matter from crops grown for the purpose.

Although the food elements in a commercial fertilizer form but one of the several conditions needed for the best development of the crop, it is important that these elements should be suited to the demands of the crop at every stage of its growth, else the product will not be as large as the other conditions would permit. It is the most common practice to use this class of fertilizers with the annual crops, and there are good reasons for such practice, as shown by fertilizer experiments.

Annual crops, whether oats, corn, potatoes, or vegetables, require that their food elements shall be ready to hand as their growth makes new demands. The commercial fertilizer, then, should be able to furnish available food elements throughout the growing season, and in the proper proportion required by the crop.

A study of the chemistry of plant growth shows very clearly that there must be present a continuous supply of available nitrogen, which requires that some shall be in the inorganic and some in organic form.

The more quickly the crop is to be grown in the spring the more inorganic nitrogen will be needed, since it is sooner ready for the plants than organic forms. Soluble phosphoric acid produces results more quickly and thoroughly than the other forms, and a well-made fertilizer should have at least half of its available phosphoric acid in the soluble form. All crops remove from the soil much more potash than phosphoric acid, and although the soil may furnish some of it, without the positive evidence of field experiments to that effect, a fertilizer should have at least as much potash as it has soluble phosphoric acid.

Commercial fertilizers may be advantageously used in top-dressing grass, and for such a purpose it should have a high percentage of nitrogen, of which nearly all should be inorganic. The phosphoric acid should be nearly all soluble in order to be of marked benefit, and the fertilizer should be applied in early spring while the soil is thoroughly moist.

Finally, in the purchase of fertilizers it should be borne in mind that it costs just as much to mix, bag, freight, and handle a ton of low-grade fertilizer as one of high grade. By purchasing a half ton of the highest grade goods one buys more and better nitrogen, as much potash, and enough phosphoric acid to balance them, for less money than he would pay for a ton of low-grade goods, because he saves half the cost of the above different items.

WEIGHT OF LIME PER BUSHEL.[a]

In conneeton with a very thorough study of the quality of various kinds of lime used for agricultural purposes in New Jersey, L. A. Voorhees, of the New Jersey Station, made careful estimates of the weight per bushel of the different materials.

His results show "that the weight of stone lime per bushel (heaped measure) is quite variable and without any constant relation to the analysis of the samples. The average weight per bushel of the twelve magnesian limes was 97 pounds, and that of the six 'marble' limes was 101 pounds." The weight per bushel of seven oyster-shell limes examined varied from 39 to 75 pounds, averaging 51½ pounds. The prepared or so-called "agricultural" limes examined were still more variable in weight.

[a] Compiled from New Jersey Stas. Bul. 183; Penn. Dept. Agr. Bul. 61.

In this connection it should be stated that in an investigation of lime in Pennsylvania, which was conducted by Dr. William Frear, of the Pennsylvania State Experiment Station, * * * a more elaborate endeavor was made to determine this point. In this case the weights per bushel were secured from the lime burners, a bushel being weighed "struck," and the replies tabulated and averaged. Doctor Frear states: "The weight of a bushel of lime is much more variable than is commonly supposed. Lloyd [a] says: 'A ton of lime equals about 27 bushels'—that is, a bushel weight is 75 pounds. Roberts [b] also says briefly: 'Seventy-five pounds of stone lime are sold for a bushel at the kilns at Union Springs, N. Y.' "

"Cook [c] states that a bushel of good stone lime, unslaked, weighs 93 pounds; of oyster-shell lime, 60 pounds; of magnesian stone lime, 80 pounds. Legal weights for a bushel of unslaked lime have been established by several States, as follows: In Ohio and Michigan, 70 pounds; in Virginia, Georgia, Illinois, Iowa, Kansas, Nebraska, and Colorado, 80 pounds.[d] In Pennsylyania the more commonly accepted bushel weight is 72 pounds." * * *

"The wide range from 60 to 100 pounds per bushel is thus reported, for stone limes, the average for the twenty-three sorts being 76.2 pounds. There is no clearly distinguishable relation between the composition of the stone and the weight of the lime; * * * the porosity of the original stone is clearly the most influential factor, to which no doubt the conditions of burning add another potent influence."

As compared with these figures the bushel weights reported by Voorhees are high, "although, of course, allowance must be made for the fact that they represent a generously heaped measure," which is a common method of measuring lump lime in New Jersey.

In the same manner the weights of a struck bushel of slaked lime seem to vary and run correspondingly high, averaging 61 pounds per bushel of magnesian lime and 51 pounds per bushel of "marble" lime.

Comparing these two sets of figures in connection with the observed yields of slaked lime from 100 parts of stone lime, which are 131 parts from magnesian lime and 157 from marble lime, it will be found that the yield of a bushel of magnesian stone lime is 2.1 bushels of slaked lime, and from a bushel of "marble" lime, 3.1 bushels of slaked lime.

In the report of the New Jersey Station for 1881 these yields are given as follows:

"A bushel of good stone lime weighs 93 pounds; when slaked it will measure near 3 bushels, each of which will weigh about 45 pounds.

"A bushel of unslaked oyster-shell lime weighs 60 pounds; when slaked it will measure something over 2 bushels, each of which will weigh 40 pounds.

"A bushel of magnesian stone lime weighs 80 pounds; when slaked it measures about 2 bushels, each of which will weigh 55 pounds."

SPREADING LIME.[e]

In view of the renewed interest in liming of soils and a widespread desire for information regarding the best methods of applying lime, the following statements by C. E. Thorne, of the Ohio Station, on the latter subject are believed to be especially timely:

How to apply lime.—One way of applying lime is to distribute the freshly-burned lump lime in small piles over the field after the land has been prepared for the crop, throw a little water on the lime, cover it with fine earth, and after it has thoroughly slaked mix it with

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[a] Science of Agriculture, p. 119.
[b] Fertility of the Land, p. 305.
[c] New Jersey Stas. Rpt. 1881, p. 31.
[d] U. S. Dept. Agr. Rpt. 1880, p. 227.
[e] Compiled from Ohio Sta. Bul. 159.

more earth and distribute with the shovel. Half a peck of lime to the square rod would give 20 bushels, or 1,400 pounds, to the acre. As lime absorbs nearly one-fourth its weight of water (24 per cent) in slaking, this would give about 1,750 pounds of slaked or hydrated lime per acre.

Slaked lime is a disagreeable material to handle, but it is sometimes applied in this condition, being spread from wagons; but any method of hand spreading involves irregularity in distribution and therefore a waste of material. Slaked lime may be successfully spread with the ordinary manure spreader by first placing a quantity of litter on the spreader apron to prevent the lime from sifting through and to bring it within reach of the teeth of the spreader and setting the apron to travel slowly.

The best manure spreaders are now fitted with hoods and slow gearing for lime spreading.

It is very difficult to spread lime satisfactorily with the ordinary fertilizer drill, because the fine powder packs above the feeders and fails to run out evenly. Moreover, these drills are not usually made of sufficient capacity to apply more than about 500 pounds of material per acre.

The best form of lime for this work is the ground quicklime which is now made by several manufacturers for building purposes, it being more convenient to handle in this form than in lumps. Such lime can be used in the fertilizer drill when fresh and coarsely ground, though it usually contains considerable fine dust which interferes with distribution by that implement.

The most satisfactory implement for distributing lime is one made especially for that purpose. Such machines are made by several manufacturers of fertilizer drills. We have found a homemade lime spreader in use in Stark County, Ohio, and give the following directions for making it:

A homemade lime spreader.—Make a hopper, similar to that of an ordinary fertilizer drill, except that it should be 8 or more feet long, with sides and top 18 to 24 inches wide. For the bottom get two pieces of heavy galvanized sheet iron 6 inches wide and as long as the hopper; have a row of holes cut in the middle of each piece, the holes being 1 inch wide by 2 inches long and 8 inches apart. Cut the holes so that they will register. Fasten one strip to the hopper as a bottom. Let the other strip slide under the hopper, moving upon supports made by leaving a space for it about bands of strap iron, which should be carried around the hopper every 2 feet to strengthen it. To this under strip or plate rivet a V-shaped arm, extending an inch in front of the hopper, with a half-inch hole in the point of the V, in which drop the end of a strong lever, bolting the lever loosely but securely to the side of the hopper 3 or 4 inches above the bottom. Let the lever extend 6 or 8 inches above the top of the hopper and fasten to the top of the hopper a guide of strap iron, in which the lever may move freely back and forth. The object of this lever is to regulate the size of the openings by moving the bottom plate. Make a frame for the hopper with a tongue to it similar to the frame of an ordinary grain drill.

Get a pair of old mowing-machine wheels, with ratchets in the hubs, and two pieces of round axle of sufficient length to pass through the wheels and frame and into the ends of the hopper, where they are welded to a bar of iron 1¼ inches in diameter and the length of the inside of the hopper. The axles should be fitted with journals bolted to the underside of the frame.

Make a reel to work inside of the hopper by securing eight short arms of one-fourth-inch by three-fourths-inch iron to the axle and fastening to these four beaters or wings of one-fourth-inch by five-eighths-inch iron and about an inch shorter than the inside of the hopper, the reel being so adjusted that the wings will almost scrape the bottom of the hopper but will revolve freely between the sides. These arms may be made of two pieces, bent so as to fit around the axle on opposite sides, and secured by small bolts passing through the ends and through the beater which is held between them. The diameter of the completed reel is about 5 inches and its length an inch or so less than that of the inside of the hopper. This reel serves as a force feed.

Tack two pieces of oilcloth to the bottom of the hopper, one in front and one behind, of sufficient width to reach the ground. These are to reduce the annoyance to man and team of the flying lime dust.

These mechanical spreaders are not as a rule adapted to the large applications of lime commonly employed in former years, but since modern practice tends toward smaller applications (one-half to 1½ tons per acre) at shorter intervals (five to six years) they may well replace hand spreading.[a]

SOIL STERILIZATION.[b]

The investigations of the Massachusetts Station on this subject are reported in an earlier bulletin of this series.[c] In recent publications of the Vermont Station, W. Stuart reviews the history of the development of the process of soil sterilization and gives the following brief account of his own experiments on the subject:

The serious nematode injury suffered by a crop of tomatoes grown in the station greenhouse in the winter of 1902-3 showed that the winter forcing of tomatoes and cucumbers could not be successfully accomplished there unless the soil was sterilized. Since the larger portion of the space devoted to these crops was occupied by solid beds, it was thought desirable to attempt sterilizing this soil in place. Three-inch draintiles were sunk about 10 inches below the surface of the soil. The lines of tile were laid every 16 inches, each line being independent of every other and connected with the surface by a vertical section of draintile. The ends of each line of tile were plugged with paper and soil. The upright was connected with the laterals by a hole drilled through the upper surface of the end tile over which it was securely cemented. The verticals were connected alternately at one end or the other of the laterals, thus permitting the live steam to be injected at opposite sides of the bed, and thus equalizing the diffusion of heat throughout the soil. Not only were the tile joints open, but each section of tile was perforated with a quarter to a half-inch hole through each side, the better to facilitate the escape of the steam. Under a pressure of from 40 to 60 pounds of steam, a section of bed, containing a surface area of nearly 70 square feet, could be heated up to about 210° F. in approximately three hours' time. The surface of the soil being well covered with burlap, this temperature was maintained for a considerable period. In one case noted the thermometer stood at about 130° F. twenty-four hours after treatment. This procedure proved in every case an effective remedy against nematodes and obviated the labor involved in treating the soil in a box or other specially constructed device. The tile once placed lie so deep that they need not be molested in digging over the beds or in changing the soil, and they are always ready for use in subsequent treatments of new soil. Then, too, the surface connection by means of vertical section afforded ideal soil aeration.

Since nearly 200 feet square of bench surface in one of the greenhouse rooms was fitted up for subwatering by means of galvanized iron pans and layers of porous bricks, the question arose as to whether it was feasible to sterilize the soil in these benches by injecting steam into the pan through the watering tube. A thorough trial of this scheme showed that while it was possible thus to sterilize soil it could hardly be called a practical method, as it took too much steam to do it. It was found that the injection of steam into a pan full of cold porous bricks resulted in a very considerable condensation of water, in fact, almost to the point of complete saturation of bricks and soil. In view of this experience it would seem to be more economical to employ a sterilization box for the treatment of soil in subwatered benches.

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[a] See also U. S. Dept. Agr., Farmers' Bul. 77, revised.
[b] Compiled from Vermont Sta. Bul. 119; Rpt. 1905, p. 297.
[c] U. S. Dept. Agr., Farmers' Bul. 186, p. 8.

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These trials therefore indicate that the first method described above, namely, sterilization of the soil in a solid bed, using 3-inch draintiles laid 10 inches deep and 16 inches apart as steam conduits, is practical and involves less labor although possibly requiring a greater volume of steam than would be necessary in treating the soil in a box or other specially constructed device. They also indicate that sterilization of the soil in place in beds subwatered by means of galvanized pans and layers of porous bricks is too wasteful of steam to be considered a practical method.

The experiments of the Vermont Station agree with those of the Massachusetts Station in showing that soil sterilization is an effective means of preventing or controlling some of the worst enemies of greenhouse plants. Professor Stuart considers it "one of the most important of the more recent developments of greenhouse technique" and believes that "on account of the severe injury so frequently caused by nematodes to tomatoes and cucumbers when grown under glass the sterilization of greenhouse soil has become almost a necessity when the soil is thus infested."

WEIGHTS PER BUSHEL OF SEEDS.[a]

The following tables, prepared from data compiled by E. Brown, of the Bureau of Plant Industry of this Department, give the legal weights, the customary weights in local use, and the customary weights used by seedsmen.[b]

Mr. Brown calls attention to the fact that "while the selling of seeds by the measured bushel has largely disappeared in the trade, the weight per bushel still has an important value in determining grade, especially in grass seeds, which vary greatly in quality. * * * The weights per bushel of grains do not vary as much as do those of grass seeds; but nevertheless the weight per bushel is an important factor to be considered in grading."

LEGAL WEIGHTS PER BUSHEL.

The legal weights taken from the latest statutes for each State are shown in the following table, in which all of the States and Territories are represented except the District of Columbia, Indian Territory, Nevada, New Mexico, Utah, and Wyoming, which have no legal weights.

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[a] Compiled from U. S. Dept. Agr., Bureau of Plant Industry Bul. 51.

[b] For weights per quart of different concentrated feeds, see U. S. Dept. Agr., Farmers' Bul. 222.

Legal weights per bushel of seeds.

State or Territory.	Apple seed.	Barley.	Beans.	Blue grass.	Broom corn.	Buckwheat.	Castor beans.	Chestnuts.	Clover.	Corn in ear.	Corn in ear, unshucked.	Corn, shelled.	Cotton, sea-island.	Cotton, upland.	Cowpeas.	English blue grass.	Flax.	Hemp.
Alabama		47	60							70	75	56		32				
Arizona		45	[a]60									54						
Arkansas		48	[b]60	14	48	52			60	70	74	56		33⅓			56	
California		50				40						52						
Colorado		48	60	14		52			60	70		56						44
Connecticut		48	60			48			60			56	44	30			55	
Delaware												56						
Florida		48	60				48				70	56	46	32				
Georgia		47	[b]60	14		52			60	70		56		30			56	44
Idaho		48				42			60			56					56	
Illinois		48	[b]60	14		52	46		60	70		56					56	44
Indiana		48	60	14		50	46		60	[c]70		56						44
Iowa		48	60	14	30	52	46		60	70		56					56	44
Kansas		48	60	14		50	46		60	70		56				22	56	44
Kentucky		47	[b]60	14		56	45		60	[d]70		56				14	56	44
Louisiana		32										56						
Maine		48	62			48						56						
Maryland																		
Massachusetts		48	60			48			60			56	44	30			55	
Michigan		48	60	14		48	46		60	70		56					56	44
Minnesota		48	60	14	57	50			60	70		56						50
Mississippi		48	[b]60	14		48	46		60	72		56		32			56	44
Missouri		48	60	14		52	46		60	70		56		33			56	44
Montana		48	60	14		52			60	70		56					56	44
Nebraska		48	[b]60	14		52	46		60	70		56					56	44
New Hampshire			62									56						
New Jersey		48	60			50			64			56					55	
New York		48	60			48			60			56	44	30			55	
North Carolina		48				50			60			56		30			55	
North Dakota		48	60		30	42			60	70		56					56	
Ohio		48	60			50			60	68		56					56	44
Oklahoma		48	60		30	42			60	70		56					56	
Oregon		46				42			60			56						
Pennsylvania		47				48			60			56						
Rhode Island	40	48	60			48	46		60	70		56	44	30			56	44
South Carolina													42	30				
South Dakota		48	60		30	42			60	70		56					56	
Tennessee	40	48	60	14	42	50	46	50	60	70	74	56		28			56	44
Texas		48	[b]60			42			60	70	72	56		32			56	44
Vermont		48	62			48			60			56						
Virginia		48	[b]60	14		52		57	60	70		56		32	60		56	44
Washington		48				42			60			56					56	
West Virginia		48	60			52			60			56					56	
Wisconsin		48	60			50			60			56	44	30			56	44

[a] Small white beans 60 pounds, other beans 55.
[b] White beans.
[c] From harvest to December 1, 70 pounds; after December 1, 68 pounds.
[d] From November 1 to May 1, 70 pounds; from May 1 to November 1, 68 pounds.

Legal weights per bushel of seeds—Continued.

State or Territory.	Herd's grass.	Hungarian grass.	Italian rye grass.	Millet.	Oats.	Orchard grass.	Osage orange.	Peanuts.	Peas.	Rape.	Redtop.	Rice, rough.	Rye.	Sorghum.	Soy beans.	Timothy.	Velvet beans, in hull.	Wheat.
Alabama					32				60				56					60
Arizona					32								56					60
Arkansas				50	32	14			60		14		56	50		60		60
California					32								54					60
Colorado					32								56			45		60
Connecticut	45				32				60			45	56			45		60
Delaware																		60
Florida				50	32			22					56	56			78	60
Georgia					32				60			43	56			45		60
Idaho					36								56					60
Illinois					32								56			45		60
Indiana				50	32	14	33						56			45		60
Iowa		50		50	32		32						56	30		45		60
Kansas		50		50	32								56	56		45		60
Kentucky		50		50	32	14			60				56			45		60
Louisiana					32								32					60
Maine	45				32				60									60
Maryland					26													
Massachusetts	45				32				60			45	56		58	45		60
Michigan		50		50	32	14	33		60		14		56			45		60
Minnesota		48		48	32	14			60	50	14		56	57		45		60
Mississippi		50		50	32				60				56	42		45		60
Missouri		48		50	32	14	36		60		14		56	42		45		60
Montana		50			32				60				56			45		60
Nebraska		50		50	32		32		60				56	30		45		60
New Hampshire					32				60				56					60
New Jersey					30				60				56					60
New York	45				32				60			45	56			45		60
North Carolina					32				60			44	56					60
North Dakota				50	32				60				56			42		60
Ohio		50		50	32				60				56			45		60
Oklahoma					32				60				56			42		60
Oregon					32								56					60
Pennsylvania					32								56					60
Rhode Island		50		50	32				60				56			45		60
South Carolina																		
South Dakota					32				60				56			42		60
Tennessee		48	20	50	32	14	33	23	60		14		56	50		45		60
Texas		48		50	32								56			45		60
Vermont	45				32				60				56			45		60
Virginia		48		50	30	14	34	22			12		56			45		60
Washington					32								56					60
West Virginia					32								56			45		60
Wisconsin		48		50	32				60	50		45	56			45		60

Weights of miscellaneous seeds not included in the Table.—Amber cane, New Jersey, 57 pounds per bushel; beggar weed, Florida, 62 pounds; canary seed, Tennessee, 60 pounds; hickory nuts, Tennessee, 50 pounds; Indian wheat, Vermont, 46 pounds; Japanese barnyard millet, Massachusetts, 35 pounds; Johnson grass, Arkansas, 28 pounds; Kafir corn, Kansas, 56 pounds; popcorn in ear, Indiana, 70 pounds; Ohio, 42 pounds; Tennessee, 70 pounds; popcorn, shelled, Kansas, 56 pounds; spelt, North Dakota, 48 pounds; velvet grass, Tennessee, 7 pounds; walnuts, Tennessee, 56 pounds.

CUSTOMARY WEIGHTS PER BUSHEL.

In numerous instances the customary weights per bushel of seeds used by the trade are not the same as the legal weights. The boards of trade and chambers of commerce in the principal cities have reported the customary weights used by them, and where these differ from the legal weights they are as follows:

California.—The Merchants' Exchange of San Francisco uses the legal weight per bushel for the State of California for wheat. It also uses the following weights per bushel for the commodities named below: Barley—brewing, 46 pounds, Chevalier 53, feed 41; buck-

wheat, 50; corn, shelled, 56; oats—black feed 30, red feed 33, white feed, 35, white milling, 37; rye, 58.

Colorado.—The Denver Chamber of Commerce and Board of Trade uses the legal weights per bushel for the State of Colorado, except for buckwheat. It also uses the following weights per bushel for the commodities named below: Alfalfa, 60 pounds; amber cane, 50; broom corn, 46; buckwheat, 50; flax, 56; Hungarian millet (Hungarian grass), 48; Johnson grass, 25; Kafir corn, 56; meadow fescue (English blue grass), 24; millet, 50; orchard grass, 14; peas, 60; redtop, 14; redtop, (fancy) 32; sweet corn, 50.

Indiana.—The Indianapolis Board of Trade uses the legal weights per bushel for the State of Indiana. It also uses 56 pounds as the weight per bushel of shelled popcorn.

Kentucky.—The Louisville Board of Trade uses the legal weights per bushel for the State of Kentucky, except for barley, for which it uses the weight per bushel of 48 pounds.

Louisiana.—The New Orleans Board of Trade uses the legal weights per bushel for the State of Louisiana for wheat, shelled corn, and oats. It also uses the following weights per bushel for the commodities named below: Alfalfa, 60 pounds; barley, 48; beans, 60; broom corn, 46; buckwheat, 48; bur clover, 8; canary seed, 60; castor beans, 46; clover—alsike 60, crimson 60, red 60, white 60; corn—in ear 70, shelled Adams 50; cowpeas, 60; flax, 56; hemp, 44; Hungarian grass, 48; Japan clover, 25; Johnson grass, 25; Kentucky blue grass, 14; meadow fescue (English blue grass), 15; meadow oat grass, 14; millet—German 50, Italian 50; mustard, 58; orchard grass, 14; osage orange, 33; peas, English—smooth 60, wrinkled 56; radish, 50; rape, 50; rescue grass, 14; rye, 56; rye grass—English 20, Italian 20; sorghum, 50; sunflower, Russian, 24; teosinte, 59; timothy, 45; turnip, 58; vetch, 60.

Maryland.—The Baltimore Chamber of Commerce uses the following weights per bushel for the commodities named: Barley, 48 pounds; beans, 62; beans (State), 60; blue grass, 14; buckwheat, 48; clover, 60; corn—on cob 70, shelled 56; flax, 56; hemp, 44; Hungarian grass, 48; millet—American 50, German 50; oats, 32; oats (State), 26; orchard grass, 14; peanuts—African 32, Virginia 22, Wilmington, 28; peas, 60; peas (State), 56; redtop—chaff 14, fancy 32; rye, 56; timothy, 45; wheat, 60.

Minnesota.—The Duluth Board of Trade uses the legal weights per bushel for the State of Minnesota. It also uses the following weights per bushel for the commodities named: Flax, 56 pounds; macaroni (durum) wheat, 60. The Minneapolis Chamber of Commerce uses the legal weights per bushel for the State of Minnesota, except for barley, for which it uses the weight per bushel of 50 pounds.

Mississippi.—The Meridian Board of Trade uses $33\frac{1}{3}$ pounds as the weight per bushel for cotton seed.

Missouri.—The Merchants' Exchange of St. Louis uses the legal weights per bushel for the State of Missouri and also uses the following weights per bushel for the commodities named: Hickory nuts, 50 pounds; peanuts (dry southern), 22; walnuts, 50.

Nebraska.—The Omaha Board of Trade uses the legal weights per bushel for the State of Nebraska, except for sorghum, for which it uses the weight per bushel of 50 pounds.

New York.—The New York Produce Exchange uses the legal weights per bushel for the State of New York, except for flax. It also uses the following weights per bushel for the commodities named: Blue grass, 14 pounds; flax, 56; orchard grass, 14; redtop, 14.

Ohio.—The Cincinnati Chamber of Commerce and Merchants' Exchange uses the legal weights per bushel for the State of Ohio, except for Hungarian grass, for which it uses the weight per bushel of 48 pounds. The Cleveland Chamber of Commerce uses the legal weights per bushel for the State, except for popcorn in ear, for which it uses the weight per bushel of 40 pounds. The Columbus Board of Trade uses the legal weights per bushel for the State. It also uses the following weights per bushel for the commodities named: Blue grass, 14 pounds; broom corn, 46; canary seed, 60; cane, 50; castor beans, 46; Japan clover, 20; Kafir corn, 50; meadow foxtail, 25; orchard grass, 14; osage orange, 33; peanuts, 24; pearl millet, 56; peas (wrinkled), 56; redtop, 14; sorghum, 50; sweet vernal grass, 10; tall meadow oat grass, 12; wood meadow grass, 14.

Pennsylvania.—The Philadelphia Produce Exchange uses the legal weights per bushel for the State of Pennsylvania, except for barley, for which it uses the weight per bushel of 48 pounds.

South Carolina.—The Columbia Chamber of Commerce uses the weight per bushel of 45 pounds for sea-island cotton seed.

Virginia.—The Richmond Grain and Cotton Exchange uses the weight per bushel of 32 pounds for oats.

Wisconsin.—The Milwaukee Chamber of Commerce uses the legal weights per bushel for the State of Wisconsin. For corn, on cob, it also uses the weight per bushel of 75 pounds from harvest to January 1 and 75 pounds after January 1.

SEEDSMEN'S WEIGHTS PER BUSHEL.

Mr. Brown states that seedsmen handle a large number of grass and forage-plant as well as other seeds, for few of which legal weights per bushel have been established. The following table shows the customary weights per bushel used for these seeds by representative seedsmen in the different States. In most instances two weights are given, indicating the differences in quality recognized in the trade.

Well-cleaned seed of good quality will weigh approximately as much as the higher weight given.

Seedsmen's customary weights per bushel of seeds.

Kind of seed.	Pounds per bushel.	Kind of seed.	Pounds per bushel.
Alfalfa	60	Meadow grass—Continued.	
Amber cane	45-60	Wood	14-24
Bent grass:		Millet:	
Creeping	10-20	Barnyard	30-60
Rhode Island	10-15	Broom corn	45-60
Bermuda grass	24-36	Common	48-50
Bird's-foot clover	60	German	48-50
Bitter vetch	60	Golden Wonder	48-50
Blue grass:		Hungarian	48-50
Canada	14-20	Pearl	48-56
Kentucky	14-30	Milo maize	50-60
Texas	14	Oat grass:	
Broad bean	50-60	Tall	10-14
Brome, awnless	10-14	Yellow	7-14
Broom corn	45-60	Orange cane	45-60
Bur clover:		Orchard grass	10-18
Hulled	60	Pea:	
Unhulled	8-10	Field	60
Spotted	60	Garden, smooth	60
Castor bean	46-60	Garden, wrinkled	56
Clover:		Peanut	20-30
Alsike	60	Rape, winter	50-60
Crimson	60	Redtop:	
Egyptian	60	Chaff	10-14
Mammoth	60	Fancy	25-40
Red	60	Rescue grass	12-28
White	60	Rice	43-45
Cowpea	56-60	Rye grass:	
Crested dog's-tail	14-30	English	10-30
Fescue:		Italian	14-25
Hard	12-16	Sainfoin	14-32
Meadow	14-24	Serradella	28-36
Red	12-15	Soy bean	58-60
Sheep's	12-16	Spelt	40-60
Tall	14-24	Sunflower	24-50
Various leaved	14-18	Sweet clover:	
Flat pea	50-60	Hulled	60
Flax	48-56	Unhulled	33
Hemp	40-60	Sweet corn (according to variety)	36-56
Japan clover:		Sweet vernal, perennial	6-15
Hulled	60	Teosinte	40-60
Unhulled	18-25	Timothy	45
Johnson grass	14-28	Velvet bean	60
Kafir corn	50-60	Vetch:	
Lentil	60	Hairy	50-60
Lupine, white	50-60	Spring	60
Meadow foxtail	7-14	Water grass, large	14
Meadow grass:		Wild rice	15-28
Fowl	11-14	Yellow trefoil	60
Rough-stalked	14-20		

It is evident that there is a confusing variation in both legal standards and common usage as regards weights per bushel. In the interest of both farmer and dealer there should be greater uniformity.

DISEASE AND INSECT RESISTANT CROPS.[a]

Enormous crop losses are caused by the attacks of insects and plant diseases. In dry weather insects are particularly abundant, and in wet weather plant diseases flourish, while in average weather both do

[a] Compiled from Colorado Sta. Bul. 104; Maine Sta. Rpt. 1903, p. 181; Minnesota Sta. Bul. 87; Vermont Sta. Buls. 115, 122, Rpt. 1902, p. 225; U. S. Dept. Agr., Bureau of Plant Industry Bul. 87.

the best they can to gather the crop before the farmer does. Many plant diseases and insects can be controlled by the various poisons, sprays, and cultural methods already discovered, but for some—as, for example, the rust of wheat, peach yellows, clover-seed fly, etc.—satisfactory remedies have not yet been discovered. Even the remedies we have for some of our farm pests entail considerable expense in their application and are not always effective. It is therefore of great importance to know whether it is possible to secure varieties of crops which are immune or less subject to attack by insects or diseases, and which will succeed where other varieties fail.

Some instances may be cited to show just what is meant by resistant or immune vareities and their value. Grapes furnish a striking example. European grapes planted in this country fail wherever the American grape-root louse is present, because the louse is able to attack and destroy the roots of these varieties. The roots of native American grapes are also attacked by the same louse, but are so hard and wiry that the louse can not destroy them. In other words they are resistant. The unusual resistance of the Keiffer pear to blight has made it possible to grow this pear in the Southern States, where most other varieties fail because of blight. The variety of cowpea known as Little Iron has proved so resistant to wilt disease that in some fields it has survived when all other varieties have been killed by the disease. American gooseberries are but little subject to the mildew which seriously affects the larger English varieties grown here. With nearly every crop grown some of its varieties are more resistant or immune to some disease or insect attack than others.

It has long been known that plants vary widely in their power of resistance to disease. Not only do certain kinds of plants seem to be almost immune to diseases of every kind, but some varieties of the same plant are but little affected by disease while others are badly injured by diseases. Variations in this respect also extend to individual plants of a given variety. These facts have been utilized to some extent in the origination of the various so-called "disease-proof" varieties which have been introduced into culture—as, for example, the "rust-proof" varieties of wheat, oats, etc. As a rule, however, these varieties have not been developed by any systematic scientific methods of selection and breeding, and although a few show merit, most of them have not measured up to the claims made for them. They have, however, served a very useful purpose in turning the thought of scientific and practical men as well, in the direction of the development of disease-resistant varieties with results which promise to prove of great practical utility. Considerable work along this line has been done abroad, especially in Great Britain, Germany, and France, and the subject is beginning to receive the attention it deserves in this country.

POTATOES.

During recent years the disease resistance of potatoes especially has received attention by several of the agricultural experiment stations in the United States, notably those of Maine, Minnesota, and Vermont. A recent bulletin of the Bureau of Plant Industry of this Department, prepared by L. R. Jones, of the Vermont Station, summarizes and discusses this work and that along similar lines abroad, as well as the experience of practical growers on the same subject. Summarizing the results, Professor Jones draws the following tentative conclusions:

Disease resistance in potatoes is relative, not absolute, no variety known being wholly proof against late blight and rot. It seems related to general vegetative vigor, and is, therefore, in a measure dependent upon cultural and developmental conditions and tends to decrease with the age of the variety. It can be restored by originating new varieties from seed, especially of hybrid origin. Not all seedlings show superior disease resistance. * * *

Early varieties may escape the disease by maturing before it becomes epidemic, but when similarly exposed they are, as a class, less resistant than late varieties.

The source of seed tubers is a matter of importance, northern-grown seed giving plants of superior disease resistance in Europe. Seed from a crop that was not too highly fertilized is probably preferable. Possibly tubers are better for seed purposes if dug before they reach full maturity. High fertilization, especially with nitrogenous manures, lowers the power of the plant to resist both blight and rot.

Varieties relatively rich in starch are more resistant to rot; those richer in protein are more susceptible to it. So far as skin characters are an index, the red varieties with thick and rough skin seem more resistant as a class than the thin-skinned white varieties. So far as stem and foliage characters are concerned, the evidence favors the stem that is hard, rough, and rather woody at the base, and the leaf that is small, somewhat rough, and dark colored.

The varieties rated highest as to disease resistance in England are Evergood, Discovery, Royal Kidney, Northern Star, Sir John Llewelyn, King Edward VII, Eldorado, and Factor. In Germany and Holland the following represent the best types: Mohort, Irene, Geheimrat, Thiel, Professor Wohltmann, Boncza, Eigenheimer, and Paul Krüger. In Belgium and France no improvement as to disease resistance has been made over the best English and German types.

In America trials as to disease resistance have been conducted at some of the experiment stations, notably in Vermont, where experiments in breeding and selection for increased resistance are under way. These results have been correlated with information recently secured by a circular of inquiry addressed to a large number of potato specialists in the Northeastern States and in Canada. From these it appears that a wide variation is shown in disease resistance among the varieties now in cultivation in America, but that no one variety is preeminent. Among those which have been widely tested the following deserve mention as of the resistant class: Dakota Red, Rustproof, Irish Cobbler, Sir Walter Raleigh, Doe Pride, and White Beauty. Certain European varieties of the disease-resistant type seem to retain that character when grown in this country—e. g., Professor Maercker and Sutton Discovery. There is much of promise in certain new varieties under trial at the Vermont Station.

In tests made by W. Stuart at the Vermont Station in 1905 the following varieties showed marked resistance to blight on both sandy loam and clay loam soils: Keeper, American Wonder, Dakota Red, Doe Pride, and Late Blightless.

It was found that on both the sand and clay soil the Dutch, German, and English-Scotch varieties showed much less rot than did the French and American varieties. * * * In general, varieties having a strong, woody, moderately branched upright haulm and medium sized, rather thick, more or less crumpled, firm, hairy leaves were found more resistant to disease, especially late blight, than those possessing rather weak, partially woody, much branched, decumbent haulms, with rather large, thin, smoothish, soft leaves. In brief, varieties having an upright habit of growth, moderately branched, with firm, hairy, medium-sized leaves are much more likely to prove resistant to late blight than are those with large, smooth, flabby leaves and decumbent stems.

Professor Jones calls attention to the fact that several new sorts of potatoes of reputed disease resistance have recently been placed on the market by American seedsmen, e. g., Harris Snowball, Dibble Ionia Seedling, Burpee Vermont Gold Coin, and Johnson Norcross, Star of the East, and Babbitt, and recommends those who have opportunity to carefully observe the relative disease resistance of these and also of other new varieties.

The evidence at hand seems to justify the hope that the coordinated efforts of potato specialists working from both the practical and the scientific standpoints may soon result in the development of varieties of potatoes combining general excellence with a high degree of disease resistance. All who can do so are urged to aid toward the accomplishment of this end.

CANTALOUPES.

In a recent bulletin of the Colorado Station P. K. Blinn reports the discovery by a local grower of a rust-resisting cantaloupe which promises to be of immense value to the Rockyford cantaloupe industry. In this case seed of the Rockyford variety was purchased from five different seedsmen. They were planted and cultivated under similar conditions. When rust attacked the field just before the melons began to ripen, it developed rapidly and soon destroyed all the vines except those grown from the seed of one seedsman. Many of the hills from this strain of Rockyford seed remained green throughout the season and produced a good crop of melons. Further observations in the muskmelon fields of that neighborhood also showed that wherever this strain of Rockyford seed had been used many hills were unaffected with rust, while with other strains of seed of the same variety the vines were all dead.

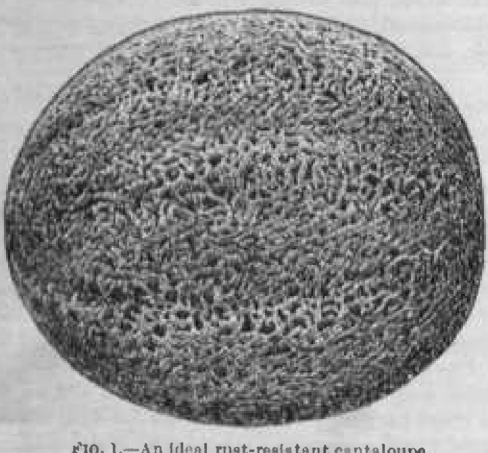

FIG. 1.—An ideal rust-resistant cantaloupe.

Mr. Blinn selected a quantity of seed from the rust-resistant hills and planted them in comparison with ordinary seed. "On the rust-resisting hills the melons were hidden under a healthy growth of vines, and were large, solidly netted, with thick, firm flesh, small seed cavity completely filled with seed. On the rusted hills the plants were almost devoid of leaves and the small melons were prematurely ripe, with thin, watery flesh, large, open seed cavity, and practically of no market value." (Figs. 1 and 2.)

In tracing back the history of this strain of seed it was found that some years before a seedsman had saved the first lot from a single healthy melon taken from a field of rusted vines. It had therefore been developed by the simple process of saving seed from the best melons produced by plants which withstood attacks of rust when surrounding plants were destroyed by this disease. What was thus accomplished by one farmer with one crop can probably be accomplished by other farmers with the same or with other crops, if they will be alert, while the crops are growing, to select and mark individual plants which show exceptional merit along the lines of prolific yield, early maturity, resistance to disease, or other desirable quality, and save seed separately from the plant showing such qualities. Marked variations which may be profitably utilized in this way are constantly occurring and are plainly evident on all farms.

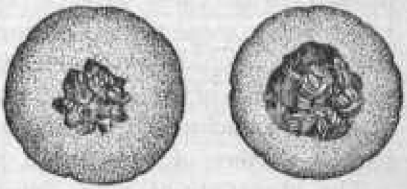

FIG. 2.—Sections of cantaloupes showing good and poor internal qualities.

The point to be emphasized is that improvements in farm crop varieties nearly always trace back to individual plants. No one is in better position to notice these exceptional plants than the farmer. He is in his fields, garden, or orchard every day, where these exceptional plants are produced. If one plant in a rust-infected wheat field stands up green and free from the disease, that is a plant to save seed from as the basis of a rust-resistant strain. If one hill of potatoes in a blighted field remains unaffected by disease, seed from that hill may produce a blight-resistant variety. If a squash plant is found that is distasteful to the squash bug, seed from that hill may produce squash vines which the bugs will not molest.

The important fact is that some plants are much more resistant to disease and insect attacks than others. It is a question of seeing the resistant plant and propagating from it. The farmer has as great opportunity for doing this as the seedsman.

CULTURAL METHODS OF CONTROLLING CORN BILLBUGS AND THE CORN ROOT-LOUSE.[a]

Corn billbugs and the corn root-louse have long been recognized as serious enemies of corn throughout the greater portion of the corn belt. For several years S. A. Forbes, Illinois State entomologist, and his assistants have been working on corn insects in general and on practical methods of controlling these pests. In a recent study of such species of corn billbugs as breed in grasses it was found that in badly infested timothy fields from 50 to 75 per cent of the timothy bulbs were injured to some extent. In fields which had been in timothy only two years the bulbs were infested to the extent of 10 to 20 per cent. It was found that at least 33 per cent ot hills of corn infested with these insects failed to form ears or filled out very imperfectly, some fields yielding only 20 to 45 bushels per acre, where the yields should have been 80 bushels. In some localities as high as 29 per cent of the hills of corn were quite badly injured, the amount of damage naturally varying according to the nearness of the field to old centers of infestation by this insect.

The observations made on corn billbugs showed clearly a great contrast in the extent of infestation between corn grown on timothy sod plowed early in the fall and that plowed only a few days before planting. A direct test of the value of fall plowing in the control of these insects showed that the injury from corn billbugs is due almost entirely to planting corn after timothy and upon spring plowing, and conversely it appeared that the injury could be effectively prevented by early fall plowing of the timothy sod. All insecticide methods of this kind recommend themselves incidentally to farmers, since the practice of fall plowing may be beneficial from a cultural standpoint and is easy of application.

Likewise with the corn root-aphis a successful cultural remedy was found. As may be generally known, this insect, like many other aphides, is cared for by certain species of ants. The ants construct their nests in the soil and care for the aphides the year round. Experiments were undertaken to determine the amount of benefit which could be derived from breaking up these ant nests by cultivation. On one farm it was found that where the soil was disked three times and harrowed once the number of ants and aphides was reduced by 92 per cent. In fact, in one instance, the insects were reduced to the extent of 89 per cent by a single treatment of the soil with a disk harrow. The disking was done on May 22 and 23, after a heavy rainfall had occurred between the 15th and 20th of the same month. In general, it is recommended that fields in which it is intended to

[a]Compiled from Illinois Sta. Bul. 104; Iowa Sta. Bul. 18; New Jersey Stas. Rpts. 1891, p. 394; 1892, p. 390.

plant corn should be thoroughly disked in the spring as soon as the ground is dry enough to work. Attention is likewise called in this case to the fact that "the treatment most effective for the destruction of the root aphis and its attendant in spring is, in a great measure, that which will be found most useful as a thorough preparation of the soil for corn." This method will not entirely eradicate the corn root-louse, but will reduce the numbers to such an extent that the injury from it will hardly be of economic importance.

ASPARAGUS RUST AND ITS CONTROL.[a]

For a number of years a serious disease has been spreading throughout the asparagus-growing districts which appears to be reducing the production to a marked extent and in some places has destroyed the plantations to a great degree. The disease is a kind of rust (*Puccinia asparagi*), all three stages of which are passed on the asparagus plant. It was first reported as being of economic importance in 1896, when it seemed to be confined to the Atlantic coast region, but since that time its spread over the entire country has been reported. It has been made the subject of much study at various experiment stations, and is one of the important lines of investigation now being carried on at the California Station.

The rust does not appear on the asparagus cut for canning or for the market, and the crop is only indirectly affected through the weakened condition of the roots and crowns. The rust exhibits three well differentiated stages. The spring form is often inconspicuous, being confined to young beds, abandoned fields, and volunteer stalks. Later the rust appears on the summer growth, and the fields take on a yellowish color, followed by red or brown, due to the abundance of the rust spores, and the death of the plant follows. The growth is prematurely arrested and with the dying down of the stalks a decay is carried to the crowns, which completes the destruction. A third form of the fungus is characterized by black spots on the stalks, within which are the winter spores and by which the fungus is carried over from one season to another. The rust is spread by winds and is doubtless introduced into new localities by roots and seeds used in starting new beds. Certain conditions of soil, moisture, and weather favor the development of the rust, moisture on the plants being essential to its attack.

When the disease first assumed importance, cutting and burning the affected plants was widely suggested, but F. A. Sirrine, of the New York State Station, found that this treatment was very injurious to

[a] Compiled from California Sta. Buls. 165, 172, Circ. 9; Massachusetts Sta. Bul. 61, Rpt. 1901, p. 69; New Jersey Stas. Rpts. 1902, p. 403, 1903, p. 504; New York State Sta. Bul. 188; North Dakota Sta. Rpt. 1903, p. 122.

the plants and should not be recommended. He carried on a series of experiments in spraying with Bordeaux mixture, to which was added a resin compound. The mixture consisted of 1 pound of copper sulphate to 8 gallons of water, with lime sufficient to neutralize the solution, and to every 40 gallons of this were added 2 gallons of a resin compound made by combining 5 pounds of resin, 1 pound of potash lye, 1 pint of fish oil, and 5 gallons of water. Every 2 gallons of this resin mixture was diluted by the addition of 10 gallons of water before mixing with the Bordeaux mixture. Three sprayings a season were given the plants, and gains of from 48 to 70 per cent in yield were noted without any injury to the plants.

R. A. Smith, of the California Station, has for a number of years been carrying on experiments to test various means for the control of this disease, and he reports success with the use of dry sulphur thoroughly dusted over the plants. The best form of sulphur to be used is the flowers of sulphur, which is the finest grade obtainable. It should be thoroughly dusted over the plants in advance of the appearance of the summer stage of the rust and one or two applications given later during the season. To make the sulphur more adherent, a spraying with whale-oil soap and water is recommended to precede the powder. The sulphur should be applied at the rate of about 150 pounds per acre for each application. The cost of the sulphur and its application was about $6 per acre for two applications in California. This treatment has proved very successful in California and is reported upon favorably by a large grower in South Carolina. It is essential to begin the treatment early, probably within three weeks of the beginning of summer growth, and to keep the sulphur showing well upon the plants throughout the season.

Some varieties of asparagus are notoriously susceptible to rust, among them the Colossal, while the Palmetto and French, or Argenteuil, are less subject to attack, and the planting of varieties which are known to be somewhat resistant and destroying all volunteer plants about fields and beds are precautions to be followed, even where spraying or dusting is practiced.

ALFALFA MEAL AS A FEEDING STUFF.[a]

Alfalfa, fresh and cured, has come to be one of the very important feeding stuffs in this country. Like other leguminous crops it has a higher percentage of protein on an average than the grasses and similar fodders. Alfalfa may be cut several times in a season. It is said that late cutting makes the best hay for horses, but that for pigs and cows the plant should be cut early. It has been suggested that grinding

[a] Compiled from California Sta. Bul. 164; Nebraska Sta. Press Bul. 20; U. S. Dept. Agr., Bureau of Animal Industry Rpt. 1904, p 242.

the cured alfalfa would prove an advantage in feeding, since the alfalfa meal could be mixed with more concentrated feeds to form a balanced ration which could be very conveniently handled and stored.

The average percentage composition of samples of alfalfa meal designed for poultry feed and analyzed at the California Experiment Station was water 10.9, protein 17.2, fat 1.6, nitrogen-free extract 36.4, crude fiber 26.3, and ash 7.6 per cent. As shown by the average of a number of analyses, the composition of alfalfa hay is water 8.4, protein 14.3, fat 2.2, nitrogen-free extract 42.7, crude fiber 25.0, and ash 7.4 per cent.

It will be seen that the meal and hay have practically the same composition, the differences in the average values quoted being no greater than might be expected in different samples of either material. This uniformity in composition is to be expected, because the grinding process alone would neither add to nor take away from the amount or proportion of nutrients present, though it might increase the digestibility of the material somewhat.

The feeding value of alfalfa meal and cut or chopped alfalfa hay was tested at the Nebraska Experiment Station with eight lots of seven pigs, averaging not far from 85 pounds each. Both the alfalfa meal and the chopped hay were prepared at the station, the meal by running the hay through a grinder and the chopped material by cutting the hay into one-half-inch lengths with a silage cutter. The test was planned so that corn meal with chopped alfalfa and corn meal with ground alfalfa hay were compared with mixtures of corn and bran and corn and shorts and with corn meal alone. Some of the mixed rations were made up of 3 parts of corn to 1 part of the other products, and others half and half. For convenience, ground corn was used with the cut or ground alfalfa hay, and the ration was moistened with water before feeding. "This prevented the feed from being blown by the wind and induced the pigs to eat up the alfalfa better than they would otherwise have done."

In the twelve weeks covered by the test the average daily gain per pig ranged from 0.8 pound with the lot fed corn and bran 3:1 to 1.096 pounds with the lot fed corn and shorts 3:1. Almost as large gains, namely, 1.071 and 1.062 pounds were made, respectively, by the lots fed corn and cut alfalfa hay 3:1 and corn and ground alfalfa hay 3:1. The gains made on corn and cut alfalfa hay and corn and ground alfalfa hay half and half were respectively 0.922 and 0.888 pound per head per day. The smallest amount of feed per pound of gain (4.66 pounds) was noted with the lot fed corn and shorts 3:1, and the largest amount (5.89 pounds) with the lot fed corn and bran 3:1. With the corn and alfalfa rations 3:1 the average amount was 4.8 pounds, and with the corn and alfalfa rations half and half 5.5 pounds. The cost

of a pound of gain ranged from 2.62 cents with the lot fed corn and cut alfalfa hay 3:1 to 3.96 cents with the lot fed corn and ground alfalfa hay half and half. The cut alfalfa hay was rated at $8 per ton and the ground alfalfa at $16 per ton.

According to E. A. Burnett and H. R. Smith, who made the test—

The price of alfalfa allows liberally for the cost of running the hay through a silage cutter, but may be too low to pay the cost of grinding. * * *

The largest daily gains were made on three-fourths corn and one-fourth shorts, but a gain practically equivalent was made at a lower cost where either cut or ground alfalfa was substituted for shorts in the ration. The cheapest gains were made on corn and cut alfalfa.

Bran did not prove equal to either shorts or alfalfa when fed as one-quarter of the ratior to pigs.

A ration three-fourths corn and one-fourth alfalfa produces greater gains than when one-half alfalfa is fed. Where alfalfa is raised on the farm, and when there is no particular need to hasten growth in the pigs, a ration one-half alfalfa hay and one-half corn may give cheaper gains than when a heavier corn ration is fed.

Hogs which have been raised largely on alfalfa pasture will learn to eat the hay in winter without cutting with a machine and to depend largely upon it where only a limited grain ration is fed, but a ration wholly alfalfa does not seem to give economical results.

The value of ground alfalfa hay was further tested with two lots of twenty-two young brood sows averaging not over 150 pounds each in weight. In eight weeks the lot fed ground alfalfa and corn 1:1 made an average daily gain of 0.98 pound per head, and the lot fed ground alfalfa and barley in the same proportion 0.84 pound. "Both these lots made fine gains and at farrowing time produced large, strong litters, showing that the ration had been nearly ideal as a ration for brood sows."

In another test a lot of thirteen mature brood sows averaging 258 pounds each in weight was fed a ration of 2 pounds of corn and 6 pounds of cut alfalfa hay. At the end of five weeks the average weight of the sows was 264 pounds each.

As their weight one week earlier was a little less than the original weight, it may be assumed that these hogs got an extra good fill before the last weight and that the ration fed was practically a maintenance ration. These sows commenced to drop litters after the fifth week, so that records could not be kept after that time. [They] * * * kept in fine condition, farrowing during February and March and saved large litters in every case. They were fed a ration one-half corn or barley and one-half alfalfa while suckling pigs.

These several tests, which included a total of 113 pigs, Professors Burnett and Smith believe give excellent proof of the high nutritive value of alfalfa hay supplemented by a small corn ration.

I. D. Graham, in a report prepared for the Bureau of Animal Industry of this Department, states that recently a number of factories equipped with more or less expensive machinery have engaged in the manufacture of alfalfa meal on a commercial scale.

In order to accomplish this, it is necessary that the hay be kiln dried, and even then it is ground at the expense of great power. Hay, as ordinarily made, is not suitable for the manufacture of alfalfa meal, because it contains too much moisture, which renders it exceedingly

difficult to grind and more liable to spoil. * * * The commercial article is made from selected alfalfa and mixed with sugar-beet molasses in the proportion of 75 per cent alfalfa and 25 per cent molasses. The product contains from 15 to 17 per cent of protein and about 50 per cent of carbohydrates and fat. It is being used by numerous feeders in the preparation of their show animals of different breeds.

In the report cited no mention is made of alfalfa meal which does not contain molasses, but apparently such a product is marketed since judging by analyses the samples examined at the California Experiment Station consisted of the ground alfalfa alone.

Alfalfa in its green state or when cured as hay or silage is a very satisfactory poultry feed. The poultry journals have recently made frequent mention of the use of alfalfa meal as a part of the ration. Regarding the value of cured and dried alfalfa for poultry, the Bureau of Animal Industry report, cited above, contains the following statements:

Poultry will feed voraciously on the dry leaves of the alfalfa plant when they have access to it, and much of the fine material shattered off from the hay in the haymow may be used to great advantage in feeding them. As this shattered material is mostly leaves, it is the best part of the plant and can be fed alone or mixed with other feed. The nitrogeneous element of alfalfa is just what is needed for the development of the young fowls, as well as for the production of eggs, and a number of so-called poultry foods are said to be composed in part of ground alfalfa. It is best for poultry to use the last cutting of alfalfa, as it is softer in texture, has a larger proportion of leaves, less woody matter, and is more succulent than any other cutting. While poultry of all classes will eat alfalfa hay, or at least the leaves from it and thrive, it is undoubtedly a better practice to chop it or grind it and mix it with a grain ration. A good practice is to steep the alfalfa hay in hot water and let it stand for several hours before feeding. If this is done and the grain ration mixed with it, the effect is practically the same as though the birds were fed on the green alfalfa. Corn meal and ground alfalfa, steeped in hot water or steamed to soften it, makes an ideal balanced ration for winter poultry feed.

The data summarized furnish additional proof, if such be needed, of the high feeding value of cured alfalfa. Whether or not the advantages which attend the use of the ground material will compensate for the cost of grinding is a question which each feeder must decide for himself.

SINGED CACTI AS FORAGE.[a]

During the periods of prolonged drought, to which the southwestern United States is liable, range cattle frequently browse upon various species of cacti common to the region.

The Arizona Experiment Station has reported the results of studies regarding the utility of this class of forage plants, particularly after the spines have been removed by burning by means of a prickly-pear burner—that is, a gasoline torch similar in principle to that which plumbers use. The spines of about 300 plants of the species of cacti

[a] Compiled from Arizona Sta. Bul. 51; Rpt. 1904, p. 496; California Sta. Rpt. 1904, p. 49; U. S. Dept. Agr., Bureau of Plant Industry Bul. 74.

commonly found in the neighborhood of the station, including prickly pears, chollas, etc., were singed, the spines being burned off at intervals for about ten days.

The first fifty plants that were singed were literally devoured by the stock, the prickly pears being eaten nearly to the level of the ground, while only the trunks and woody branches of the chollas remained. As the work was continued from day to day, it was evident that the stock [although under usual circumstances they will eat more or less of the cactus with the spines] were feeding entirely upon the singed plants, and that they readily distinguished them from the unsinged ones. This singeing and close browsing of the cactaceous plants, if continued, would surely result in their final destruction, which would add more distress to what already exists, so that in general not more than one-half of the plant should be singed, leaving the remaining half to restore the growth singed and utilized by cattle.

Conservative estimates indicate that from 7,000 to 11,000 pounds of cactus forage can be prepared daily in this way at a cost of $2.40, which represents 8 gallons of gasoline at 30 cents a gallon. The amount of water in this forage, as determined in the experiment station chemical laboratory, is approximately 75 to 80 per cent, leaving 20 to 25 per cent, or 1,600 to 2,500 pounds of solid matter for the days's work.

Cacti have been analyzed at the Arizona and the California Experiment stations. Carbohydrates constitute the principal nutritive material in the dry matter of the cacti. The amount of protein present, as in the case with most green fodders, is small. The ash content was found to be high, "suggesting an explanation of the purgative effect of this forage upon cattle."

In the above estimate no account has been taken of the possible expense of one extra man to operate the burner, since ordinarily this work can be done with the paid help already at hand. The relative value of this class of forage is as yet in question. The expense and trouble of burning, however, will be amply justified, if range stock can be successfully carried over periods of extreme shortage. The large amount of water in this forage is of no small value to thirsty, starving cattle, doubtless enabling them to feed much farther from their watering places than they could otherwise do.

J. J. Thornber, who carried on the Arizona investigations, states that in using a gasoline torch for singeing cacti, the tank should be suspended from the shoulder in such a way that the end which supplies the gasoline to the burner is always down. As a matter of economy it will be found desirable to maintain a good pressure of air in the tank, and to avoid using the burner in a brisk or even a moderate breeze, since one-third more gasoline is then required.

In connection with an extended study of prickly pear and other cacti as food for stock, carried on by D. Griffiths, of the Bureau of Plant Industry of this Department, data regarding different methods of singeing cacti, the use of the singed material as a feeding stuff, and other questions were considered.

The most prevalent practice in southeastern Colorado, according to Doctor Griffiths, consists in singeing the spines over a brush fire.

This operation is practicable where there is considerable brush or wood conveniently situated, but it has many disadvantages. The plants are collected and hauled to some convenient place where a fire is built. A brisk fire will remove the spines from one side of the

joints almost instantly. It is then necessary to turn the plants over and burn them again on the other side. Some careful feeders often leave the plant on the fire until much of the outside has turned black from the heat, in order to insure the removal of the short as well as the long spines. Others exercise less care, and simply allow the flames to pass over the plant, burning off only the distal half or more of the long spines and leaving practically all of the short ones for the cattle to contend with. It often happens that the fuel used is greasewood (*Sarcobatus vermiculatus*) or shad scale (*Atriplex canescens*), the young shoots of which are of greater nutritive value than the pear itself. On the arroyos and washes dead cottonwood timber is used, while in many localities juniper furnishes the fuel.

This is the most primitive method of feeding and one which has been practiced in Texas since before the civil war, and is still very extensively employed not only in Texas, but also in old Mexico, where singeing the thorns with brush is about the only method employed in feeding prickly pear and other species of cacti.

The use of the gasoline torch for singeing cacti, it is stated, originated in Texas and is commonly practiced on the range. It is economical from the standpoint of the labor involved, as well as from the quality of the feed.

The process consists in passing a hot-blast flame over the surface of the plant, which can be very quickly done at small expense. The spines themselves are dry and inflammable. In many species one-half or two-thirds of them will burn off by touching a match to them at the lower part of the trunk. The ease with which they are removed depends upon the condition of the atmosphere, the age of the joints, and the number of the spines. A large number of spines is very often an advantage when singeing is to be practiced, because the spines burn better when they are abundant. The instrument used for this purpose is a modified plumber's torch. Any other convenient torch which gives a good flame can be employed, the efficiency depending upon the lightness of the machine and the ease with which the innermost parts of the cactus plants can be reached by the flame.

Cattle brought up in [prickly] pear pastures do not have to be taught to eat pear. They take to the feed very naturally. After a day or two of feeding the sound of the pear burners or the sight of smoke when pear is burned with brush, brings the whole herd to the spot immediately, and they follow the operator closely all day long, grazing the pear to the ground--old woody stems and all—if the supply that the operator can furnish is short.

Pear, when burned, scours cattle much worse than when it is simply scorched enough to take the thorns off. * * * Burning with a pear burner tends to kill out the pear if close pasturing is practiced afterward. * * *

In practice pear is very seldom fed alone. Even during the severest drought cattle are able to pick up some old grass and get a little browse from the abundance of brush that exists throughout the pear region. It is seldom that the Texas rancher feeds it without some cotton-seed meal, although the cactus of southwestern Colorado has usually been fed alone.

PROFITABLE CATTLE FEEDING IN THE SOUTH.[a]

A recent bulletin of the Mississippi Station, prepared by A. Smith and C. I. Bray, states that "the farmers of that State and throughout the cotton belt generally are slow to realize the benefits of stock raising and cattle feeding and that it is more remunerative than continuous cotton growing." Cotton growing has heretofore been the chief source of revenue for the farmer—cotton is preeminently the "money

[a] Compiled from Mississippi Sta. Bul. 92.

crop" of the region—and other branches of farming have been neglected. The feeding experiments carried on at the station with 25 grade steers, 2 to 4 years old, which were classed as medium feeders, using cotton-seed hulls and meal, corn meal, wheat bran, and hay (Johnson grass and a mixture of alfalfa and Johnson grass, 2:1) furnish quite clear evidences "that the feeding of beef cattle in Mississippi is a safe and profitable investment and a much more economical way of maintaining the fertility of the soil than by purchasing fertilizers. * * *

In the wheat and corn belts, farmers have long ago discovered that the continuous sale of their crops could not be carried on indefinitely without impairing the fertility of the soil and that they must have recourse to live stock of some kind to return to the land some of the elements of plant food taken from it by the crops grown, thus preserving their farms in a state of productivity more nearly resembling the original condition of the soil. In the cotton belt the beef breeds of cattle are only beginning to take their rightful place among other farm live stock. This is largely owing to the prevailing idea among farmers that raising beef steers for market is not profitable.

Dairy farming has many good points of superiority over beef raising, but to farmers who are not close to a good market, and are handicapped by lack of available and steady labor, the breeding and feeding of cattle will offer many inducements.

That it is a profitable business in the South is shown by the low cost of raising cattle, economy in producing suitable feeds, and the inexpensive buildings required.

With a good pure-bred beef sire, a herd of native cows, and plenty of pasture land, a farmer may in two or three years time develop a good grade beef herd, which will largely increase his profits and maintain the fertility of the soil.

The comparison between the stable *v.* open-yard system while showing some advantage in favor of the stable method really indicates that a combination of the best features of both systems is preferable. This could be done by allowing the cattle to run in large sheds with a solid tight floor which should be well bedded, and the manure all saved. If desired, outside yards connected with these sheds could be provided, so that the cattle could have some exercise and plenty of fresh air. One of the secrets of successful cattle feeding is in making them as comfortable as possible.

Where cotton-seed meal and hulls can be purchased at a reasonable price, they prove to be very cheap feeds for fattening steers. No bad effects result from feeding cotton-seed meal for such short periods as this, and it remains to be seen whether any ration can be compounded exclusive of good silage, which can equal it as an inexpensive feed.

MILK FEVER.[a]

The nature of milk fever still remains somewhat doubtful despite the earnest and continued effort which has been made to determine the cause of the disease. It is generally recognized as one of the most serious troubles which affect milch cows and is particularly discouraging to dairymen for the reason that it commonly attacks the best and heaviest milkers. Until 1899 the treatment adopted for milk fever varied greatly but was unsuccessful in from 60 to 85 per cent of cases. In that year, Schmidt devised his method of injecting potassium iodid

[a] Compiled from Virginia Sta. Bul. 158.

into the udder and secured satisfactory results in from 50 to 70 per cent of cases. This method became generally known and wherever tried was so satisfactory that milk fever was a much less serious drawback to dairying than it previously had been. During experiments with the Schmidt method the use of oxygen was hit upon and later the use of filtered atmospheric air. As a result of the numerous practical tests of this remedy it appears that if applied in the early stages of the disease nearly all cases yield completely and improvement begins with remarkable promptness, usually within two or three hours after the first application. In applying the oxygen or air treatment, it is desirable in all cases to filter the air so that no bacterial impurities are carried into the udder, for if this is allowed to take place a serious infection will occur in a considerable percentage of cases and this leads to fatal results or at least to a loss of a part of the udder. The method has been thoroughly worked out and tested by the Bureau of Animal

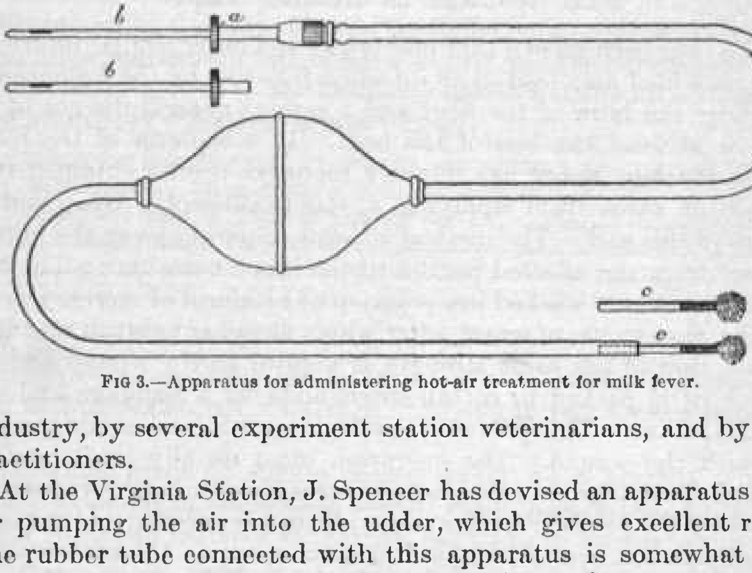

FIG 3.—Apparatus for administering hot-air treatment for milk fever.

Industry, by several experiment station veterinarians, and by many practitioners.

At the Virginia Station, J. Spencer has devised an apparatus (fig. 3) for pumping the air into the udder, which gives excellent results. The rubber tube connected with this apparatus is somewhat larger than that ordinarily used. The inlet tube *c* of the apparatus is plugged with cotton so that the air is filtered but not obstructed in passing through the tube. A medium-sized milking tube *b* is inserted in the hard-rubber pipe *a* and forced home sufficiently far to make an air-tight joint.

The treatment should be given as soon as the symptoms of the disease appear. Inserting the milking tube, which has been carefully cleansed and disinfected, into the teat, the udder, from which all milk has been removed, is pumped full of air. If the symptoms are violent, the Schmidt treatment, using a solution containing 2 drachms of potassium iodid in a quart of water, may be applied first, after which the air

treatment is given. In most cases it is found that improvement takes place within a few hours. If, however, the cow does not regain consciousness promptly, the application should be repeated, keeping the udder extended and kneading and rubbing it thoroughly until recovery takes place.

With the proper apparatus, this treatment may be applied by the average dairyman and does not require the assistance of the veterinarian. The only point of danger which the dairyman should bear in mind is the possibility of infecting the udder by unclean apparatus or by unfiltered air. When proper precautions are taken along this line, however, there is little to be feared from the use of the method. In order to avoid danger so far as possible it is best to wash the udder thoroughly with an antiseptic solution—for example, a 2 per cent solution of creolin or carbolic acid—before the air is pumped into the udder.

NAIL WOUNDS IN HORSES' FEET.[a]

It has long been known that nail pricks and other similar injuries in the horse's hoof may lead to an infection followed by the formation of pus under the horn of the hoof and a serious general disease of the horse or at least the loss of the hoof. In a bulletin of the South Dakota Station, Moore has recently reported results obtained in a number of cases from applying a strict antiseptic treatment to injuries of this sort. The method consists in paring away the horn of the hoof from the affected part until the blood oozes out. The hoof is then thoroughly washed in a solution of bichlorid of mercury at the rate of 1 part to 500 of water, after which absorbent cotton saturated in a solution of the same strength is applied to the wound and the whole hoof is packed in cotton surrounded by a bandage and well coated with tar. This prevents any further filth from coming in contact with the wound. The operation must usually be done by a qualified veterinarian. Subsequent treatment, however, can be applied by the average farmer, since all that is necessary is to pour a little of this solution of bichlorid of mercury upon the cotton which projects from the upper part of the bandage. The cotton will absorb enough of the solution to keep the wound moistened and hasten the healing process. If a remedy of this sort is not adopted in the case of foot wounds in the horse the owner runs considerable risk of serious infection either of blood poisoning or lock jaw.

USE OF A CHEAP CANNING OUTFIT.[b]

All during the growing season, on a well-established farm, there is found an abundance of fruits and vegetables from early spring, when

[a] Compiled from South Dakota Sta. Bul. 95.

[b] Compiled from Louisiana Stas. Bul. 81.

asparagus and rhubarb are in season, until the winter apples are gathered in late fall. The best of the fruits and vegetables may be marketed, but there is often a good deal of material which can not be profitably sold, and frequently goes to waste. It is in the utilization of this material that a cheap canning outfit may prove profitable.[a]

E. J. Watson, of the Louisiana Experiment Station, in a recent bulletin, gives the results secured at that station in the canning of fruits and vegetables with a canning outfit costing but $10. The results show what may be accomplished on many farms at little labor and expense, and at considerable profit.

There are a number of these cheap canning outfits on the market which do very satisfactory work with practically all fruits and with nearly all vegetables. The one used at the Louisiana Station had a capacity of three hundred 2-pound cans and two hundred 3-pound cans per day. It consisted, essentially, of a specially constructed galvanized iron boiler made to fit either a No. 7 or 8 kitchen stove, a basket or carrier that fitted inside the boiler, can tongs, and soldering irons. The station ran two of these outfits and the expense for labor and material required to run them one day in putting up six hundred 2-pound cans of tomatoes, was as follows:

Picking and delivering fruit, 2 boys at 60 cents per day each	$1.20
Scalding, peeling, filling, 2 boys at 60 cents per day each	1.20
Wiping and soldering, 1 man at $1.50 per day	1.50
Processing, 1 man at $1.50 per day	1.50
Six hundred 2-pound cans, at 2½ cents each	15.00
Solder for cans	1.00
Total cost per day	21.40

The price received for the tomatoes was 70 cents per dozen, or a total of $35, which left a balance of $13.60 to pay for the tomatoes used.

When high grade peaches or pears were put up in 3-pound cans and about 1½ pounds of sugar used for the sirup in each dozen cans, the cost of labor and material for a day's work was as follows:

For labor	$5.40
Four hundred 3-pound cans, at 3 cents each	12.00
Fifty pounds sugar, at 6 cents per pound	3.00
Total	20.40

For this grade of goods $1.75 was received per dozen cans, or $58.33. This left a balance of $37.93 for the fruit used. Peaches were also put up without sugar, using simply clear water. This grade sold as pie peaches and brought $1 per dozen. The station found that "pears yielded a larger profit than peaches, other things being equal, as 1

[a] The principles and methods of canning and preserving are fully discussed in U. S. Dept. Agr., Farmers' Bul. 203.

bushel of pears filled an average of twenty-four 3-pound cans, and 1 bushel of peaches only sixteen 3-pound cans." It costs as much to put up pears as peaches, and they sell for about the same price, grade for grade.

The details observed in the canning of tomatoes with this outfit is thus stated by the station:

In canning tomatoes the first step is to scald the fruit just sufficient to loosen the skin so that it can be slipped off. To do this, we use a large iron kettle, commonly called a "wash pot." The tomatoes are placed in a cheap tin vessel, holding about one-third of a bushel, that has been punched full of small holes, and dipped into the boiling water and allowed to remain about one minute or until the skin will slip readily. The fruit is then peeled, sliced and filled directly into the empty cans. The cans must be well filled for good results. This finishes the first step. The filled cans are then passed to the second stage of the operation. The tops of the cans wiped dry with a clean cloth, the cap placed on and soldered around the rim, the small hole or vent in the center of the cap being left open. Then we are ready for the third step, that of exhausting—expelling the air out of the cans. This is accomplished by submerging the cans in the boiling water (in the boiler) about two-thirds of their length. They are held there until they come to a boil, or for tomatoes ten minutes. They are then removed, the small hole in the center of the top closed with solder, and the cans are then completely submerged in the boiling water and boiled, or processed, twenty minutes, which is the fourth, and last, step in the operation.

The following vegetables and fruits can be successfully canned in a somewhat similar manner: String beans, asparagus, rhubarb, okra, cauliflower, strawberries, blackberries, raspberries, peaches, pears, plums, cherries, apples, figs, etc. Corn and peas can not be successfully preserved by this method unless the cans are processed for three and one-half to four hours. But even then there will be many losses from swelled and spoiled cans. A bushel of tomatoes will yield about twelve 3-pound cans of finished product.

O